



Gallatin City-County Health Department

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Protecting Yourself From Wildfire Smoke

Introduction

Wildfire smoke that infiltrates the air we breathe can pose a significant health risk to the public and particularly those with special conditions. Given this risk, during such an event that wildfires cause smoke-laden conditions in our community, the health department recommends taking precautions to help prevent any serious health complications.

Health Effects of Smoke

The effects of smoke run from irritation of the eyes and respiratory tract to more serious disorders, including asthma, bronchitis, reduced lung function and premature death. Studies have found that fine particulate matter is linked (alone or with other pollutants) with a number of significant respiratory and cardiovascular-related effects, including increased mortality and aggravation of existing respiratory and cardiovascular disease. In addition, airborne particles are respiratory irritants, and laboratory studies show that high concentrations of particulate matter cause persistent cough, phlegm, wheezing and physical discomfort in breathing. Particulate matter can also alter the body's immune system and affect removal of foreign materials from the lung, like pollen and bacteria.

Carbon monoxide enters the bloodstream through the lungs and reduces oxygen delivery to the body's organs and tissues. The health threat from lower levels of CO is most serious for those who suffer from cardiovascular disease. At higher levels, carbon monoxide exposure can cause headaches, dizziness, visual impairment, reduced work capacity, and reduced manual dexterity even in otherwise healthy individuals. At even higher levels (seldom associated solely with a fire), carbon monoxide can be deadly.

People exposed to toxic air pollutants at sufficient concentrations and durations may have an increased chance of getting cancer or experiencing other serious health problems. However, in general, it is believed that the long term risk from toxic air pollutants from forest fire smoke is very low. Some components of smoke, such as many polycyclic aromatic hydrocarbons (PAH) are carcinogenic. Probably the most carcinogenic is benzo-a-pyrene (BaP), which has been demonstrated to increase in toxicity when mixed with carbon particulate. Other components, such as the aldehydes, are acute irritants. Three air toxics are of most concern from wildfires:

1. *Acrolein*. An aldehyde with a piercing, choking odor. Even at low levels, acrolein can severely irritate the eyes and upper respiratory tract. Symptoms include stinging and tearing eyes, nausea and vomiting.

2. *Formaldehyde*. Low level exposure can cause irritation of the eyes, nose and throat. Higher levels cause irritation to spread to the lower respiratory tract.

Long-term exposure is associated with nasal and nasopharyngeal cancer.

3. *Benzene*. Benzene causes headaches, dizziness, nausea and breathing difficulties, and is a very potent carcinogen. Benzene causes anemia, liver and kidney damage, and cancer.

Not everyone who is exposed to thick smoke will have health problems. Level, extent and duration of exposure, age, individual susceptibility and other factors play a significant role in determining whether or not someone will experience smoke-related health problems.

Sensitive populations

Most healthy adults will recover quickly from smoke exposures and will not suffer long-term consequences. However, certain sensitive populations may experience more severe acute and chronic symptoms from smoke exposure. Much of the information about how particulate affects these groups has come from studies done on urban particulate. More research is needed (and some of it is underway) to determine if particulate from wildfires affects these groups differently.

Individuals with asthma, and other respiratory diseases. Levels of pollutants which may not interfere with normal breathing affect people with asthma in more profound ways, causing greater inflammation or constriction of airways. Asthma, derived from the ancient Greek word for panting, is a chronic condition in which the airways temporarily become impeded, causing labored breathing, wheezing or coughing. During an asthma attack, the muscles tighten around the airways, constricting the free exchange of air. The lining of the airways becomes inflamed and swollen. Children's airways are narrower than those of adults, thus irritation that would produce only a slight response in an adult can result in significant obstruction in the airways of a young child. Older people with asthma experience higher mortality rates from asthma than other age groups.

Individuals with cardiovascular disease. Cardiovascular diseases include many ailments, such as hardening of the arteries, high blood pressure, angina pectoris, heart attacks and strokes. It is the leading cause of death in the United States, responsible for about 42% of all deaths each year. The vast majority of those deaths are in people over the age of 65. Studies have linked particulate pollution to increased heart attacks and symptoms in those with cardiovascular disease. The exact toxicological mechanisms are

not well understood, but studies show that particulate matter causes respiratory symptoms, changes in lung function, alteration of mucociliary clearance and pulmonary inflammation that can lead to increased permeability of the lungs. This, in turn, can cause fluid to accumulate in the lungs. Mediators released during an inflammatory response could increase the risk of blood clot formation and strokes. Other studies have shown that the particles may trigger certain neurons in the respiratory tract, leading to effects on the nervous system.

The elderly. Studies estimate that tens of thousands of elderly people die prematurely each year from exposure to particulate pollution. Part of that is due to the fact that the elderly are more likely to have pre-existing lung and heart diseases. In addition, the elderly seem to be more affected than other age groups because we lose important respiratory defense mechanisms as we age. Older individuals tend to have more difficulty clearing particles from their lungs. As a result, pollutants to irritate the lungs for longer periods of time and can cause more damage. In addition, particulate pollution can compromise the immune system, increasing the susceptibility to bacterial or viral respiratory infections. This can lead to an increase incidence of pneumonia and other complications among the elderly.

Children. Children, even those without any preexisting conditions, are considered a sensitive population because their lungs are still developing, making them more susceptible to environmental threats than healthy adults. Several factors lead to increased exposure in children: compared to adults, they tend to spend more time outside; they engage in about three times the vigorous activity, and they breathe about 50% more air per pound of body weight. Studies have shown that particulate pollution is associated with increased respiratory symptoms and decreased lung function in children, including symptoms such as aggravated coughing and difficulty or pain in breathing. These can result in school absences and limitation in normal childhood activities.

Smokers. People who smoke have already compromised their lung function. Exposure to high levels of particulate can exacerbate their condition, leading to chest pain, trouble breathing and other respiratory symptoms more quickly than in non-smokers. As a way to put smoking in context, in a 10' by 13' room with an 8' ceiling, it takes only 10 minutes for the side stream smoke of 4 cigarettes to create ambient levels of particulate in the hazardous ranges ($644 \mu\text{g}/\text{m}^3$).

Judging particulate levels in smoke

Communities that have established air quality programs and alert systems traditionally base their advisements to the public on the 24 or 8 hour averages of particulate matter. However, it makes sense to approach smoke emergencies differently, for a couple of reasons. Smoke concentrations tend to be very high for a few hours, and then drop off dramatically. But, research has shown that the spikes may be what cause some of the most deleterious effects. In addition, the particulate from smoke is very small, which is what most emergency plans are based upon the $PM_{2.5}$ particulate levels.

Another factor is public perception. Since smoke is such a good scatterer of light, visibility changes drastically as smoke concentrations increase. Even without being told, the public can tell when the smoke is getting worse, and they want authorities to respond to those changes as they are happening, instead of when they have been going on for eight hours, or when they are over.

Many places don't have real-time particulate monitors to help determine how thick the smoke is. (Real time monitors give an instant (and continuous) reading of particulate concentrations.) However, visibility can serve as a good surrogate. Even in areas with monitors, this index is useful, since smoke levels are ever-changing, giving the public a way to judge the smoke levels for themselves on a continual basis.

Categories	Visibility in Miles	$PM_{2.5}$ Particulate levels (averaged 1 hour, $\mu g/m^3$)
Good	13.4 miles and up	0 – 33.5
Moderate	8.8 to 13.3	33.6 – 51.0
Unhealthy for Sensitive Groups	5.1 to 8.7	51.1 – 88.5
Unhealthy	2.2 to 5.0	88.6 – 201.0
Very Unhealthy	1.3 to 2.1	201.1 – 338.5
Hazardous	1.3 miles or less	over 338.5

Procedure for Making Personal Observation to Determine Smoke Concentrations

- Face away from the sun
- Determine the limit of your visibility range by looking for targets at known distances (miles). Visible range is that point at which even the high contrast objects totally disappear
- After determining visibility in miles, use the chart to determine health effect and appropriate cautionary statement.

At times, even the visibility index may be hard to use, especially if specific landmarks of known distance are not available for judging distances. In such cases, individuals may have to rely on common sense in assessing smoke conditions (e.g., mild, moderate, heavy smoke) and the kinds of protective actions that might be necessary.

Recommendations for the public

The following table provides a general list of probable health effects at each level, and associated recommended cautionary statements. It is based on the EPA's Air Pollution Index, as well as some work done in Montana and Washington.

Categories	Health Effect	Cautionary Statement
Good	None	None
Moderate	Possibility of aggravation of heart or respiratory disease.	People with heart or lung disease should pay attention to symptoms.
Unhealthy for Sensitive Groups	Increasing likelihood of respiratory symptoms and aggravation of lung disease such as asthma.	People with respiratory or heart disease, the elderly and children should <i>limit</i> prolonged exertion and stay indoors when possible.
Unhealthy	Increased respiratory symptoms and aggravation of lung and heart diseases; possible respiratory effects to general population.	People with respiratory or heart disease, the elderly and children should <i>avoid</i> prolonged exertion and stay indoors when possible; everyone else should <i>limit</i> prolonged exertion.
Very Unhealthy	Significant increase in respiratory symptoms and aggravation of existing lung and heart disease; increasing likelihood of respiratory effects of general population.	People with respiratory or heart disease, the elderly and children should <i>avoid</i> any outdoor activity; everyone else should <i>avoid</i> any outdoor exertion.
Hazardous	Serious aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and the elderly; serious risk of respiratory effects in general population.	Everyone should <i>avoid</i> any indoor and outdoor exertion; everyone should remain indoors whenever possible.

Precautionary Measures

There are several measures you can take to reduce your risk of harmful smoke-caused health conditions:

1. **Stay Indoors**, keeping your windows and doors closed.
2. If you do **not** have air conditioning in your home or apartment, it may be wise to **seek a clean air sanctuary** (This could be a public building such as a school, library, or mall) to avoid heat-related illnesses.
3. **Use an effective air cleaner** that is appropriate to your living space.
For more information about residential air cleaners, see www.epa.gov/iaq/pubs/residair.html .
4. **Reduce your physical activity**; exercise can increase the amount of harmful pollutants inhaled into your lungs.
5. When outdoors, **use a light mask** (ones labeled 'R95', 'N95', or 'p95' work best); bandanas and paper dust masks will **not** be sufficient for smoke particles!
6. **Reduce other sources of indoor pollution**, such as tobacco smoke.

For more information about protecting your health during wildfire season and other public health information, call the Gallatin City-County Health Department at 582-3100 or 582-3120, or visit the website at <http://www.gallatin.mt.gov/health> and click on "Public Health Information".